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INSTRUCTION MANUAL

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KEPCO

VP

design group

OVERVOLTAGE PROTECTORS

Model VP–PX

Serial No. A-42919

INSTRUCTION MANUAL

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SECTION I — INTRODUCTION

1-1 SCOPE OF MANUAL

1-2 This instruction manual contains information about the operation, installation, and maintenance of the Kepco Series VP—PAR, VP—PWR and VP—PX Overvoltage Protectors.

1-3 GENERAL DESCRIPTION

1-4 The Kepco Model VP—PAR, VP—PWR and VP—PX Overvoltage Protectors are independently powered crowbar devices which are to be used in conjunction with Kepco modular power supplies. (See Table 1—1) Only their sensing current (approx. 1 mA) is drawn from the power supply. If a failure in the power supply results in a rise in output voltage exceeding the pre-set operating level in the Model VP, the crowbar circuit shorts the power supply output through a silicon controlled rectifier (S.C.R.).

1-5 SPECIFICATIONS, ELECTRICAL

a) STATIC TRIGGER LEVEL. The operating or static trigger level may be set to as close as 5% or 0.25 V (whichever is greater) of the power supply output voltage setting.
b) TEMPERATURE COEFFICIENT: 0.1% or 0.1 volt (whichever is greater) per °C.
c) REMOTE ERROR SENSING. Sensing connections, allowing remote sensing of the load are provided. Load wire voltage drops up to 1.0 volt per output lead can be compensated.
d) TRIGGERING TIME:(adjustable delay)
5 to 10 microseconds, with adjustable delay to minimize spurious triggering and reduce false alarm rate.
e) ALLOWABLE—FAULT TIME: Infinite, VP—PAR is protected by a fuse, VP—PWR by a thermal cut—out, VP—PX is rated to sustain indefinite short circuit current.
f) OPERATING TEMPERATURE: −20°C to +65°C.
g) STORAGE TEMPERATURE: −40°C to +85°C.

MODEL	FOR USE WITH:	OPERATING RANGE
VP—PAR	All PAR Models	3 to 80 volts
VP—PWR	All PWR Models	3 to 80 volts
VP—PX	All PAX & PBX Models	3 to 110 volts

TABLE 1-1 OPERATING RANGE, VP OVERVOLTAGE PROTECTORS

1-6 SPECIFICATIONS, PHYSICAL

Refer to Mechanical Outline Drawing, FIG. 1—2.

1-7 DEFINITIONS

1-8 The graphically defined definitions (FIG. 1—1) apply to all Kepco Overvoltage Protectors and will be used throughout this manual.

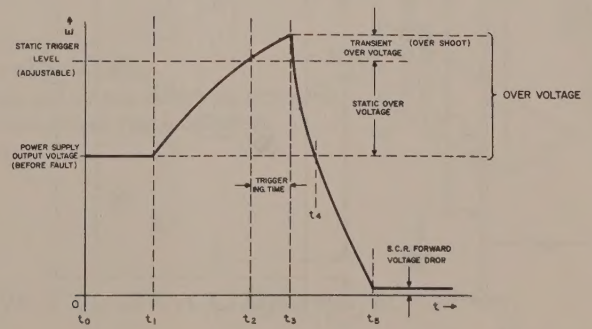
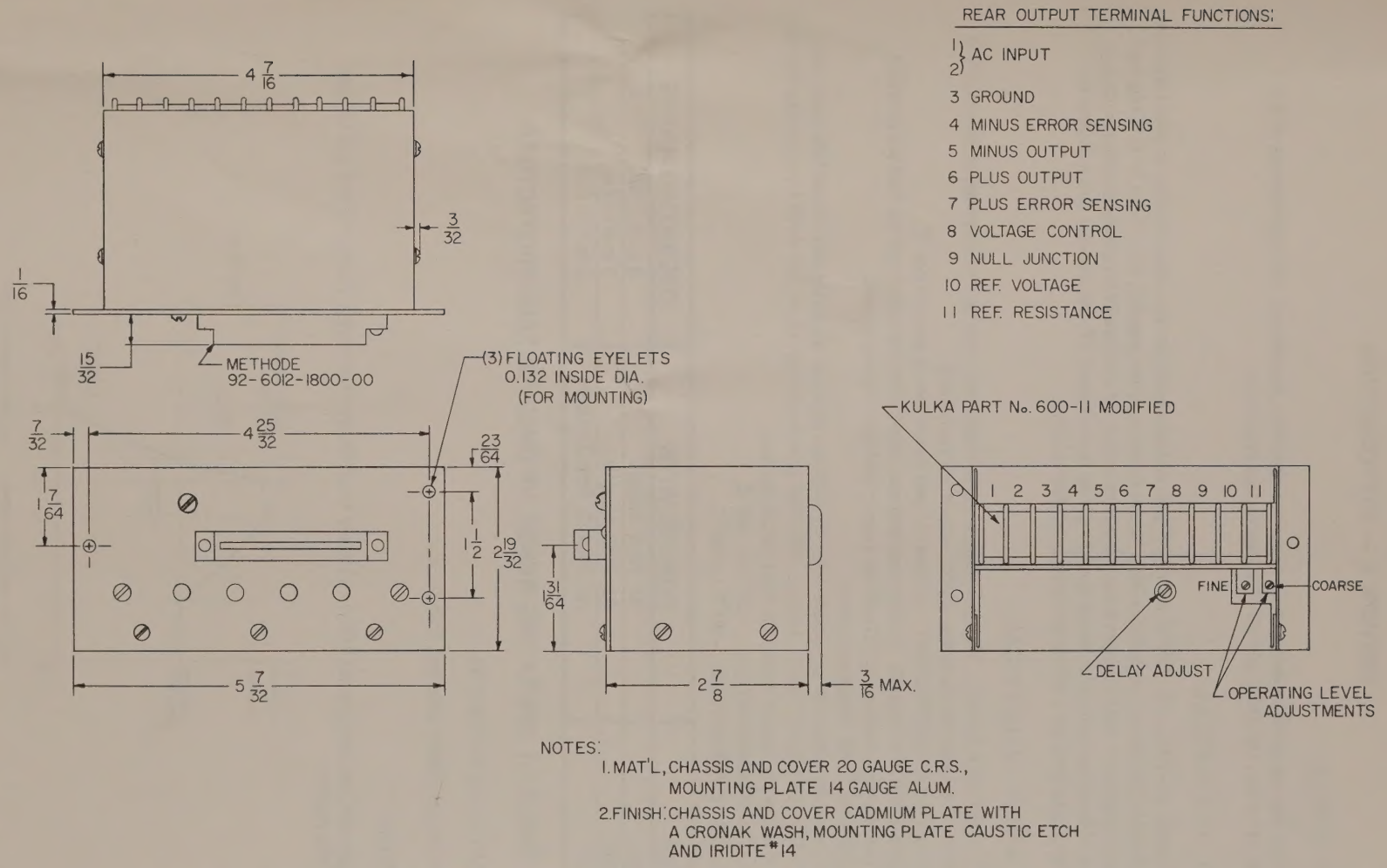


FIG. 1-1 KEPCO VP DEVICES, DEFINITIONS



NOTES:

1. MAT'L, CHASSIS AND COVER 20 GAUGE C.R.S., MOUNTING PLATE 14 GAUGE ALUM.
2. FINISH: CHASSIS AND COVER CADMIUM PLATE WITH A CRONAK WASH, MOUNTING PLATE CAUSTIC ETCH AND IRIDITE #14

FIG. 1-2 MECHANICAL OUTLINE, VP–PX

SECTION II – INSTALLATION

2-1 UNPACKING AND INSPECTION

2-2 The Kepco Overvoltage Protector (VP) has been completely tested and inspected at the factory prior to packing and is ready for installation and operation. It should be unpacked with resonable care and inspected for shipping damage. Notify the responsible carrier if any evidence of such damage exists.

2-3 INSTALLATION

2-4 Mechanical installation of the VP–PX is described and illustrated in FIG. 2–1. Electrical connection consists simply in joining the printed circuit board connector of the power supply with the mating jack on the VP–PX: Note that the connector fits only one way. A key on the mating jack of the VP–PX prevents incorrect insertion.

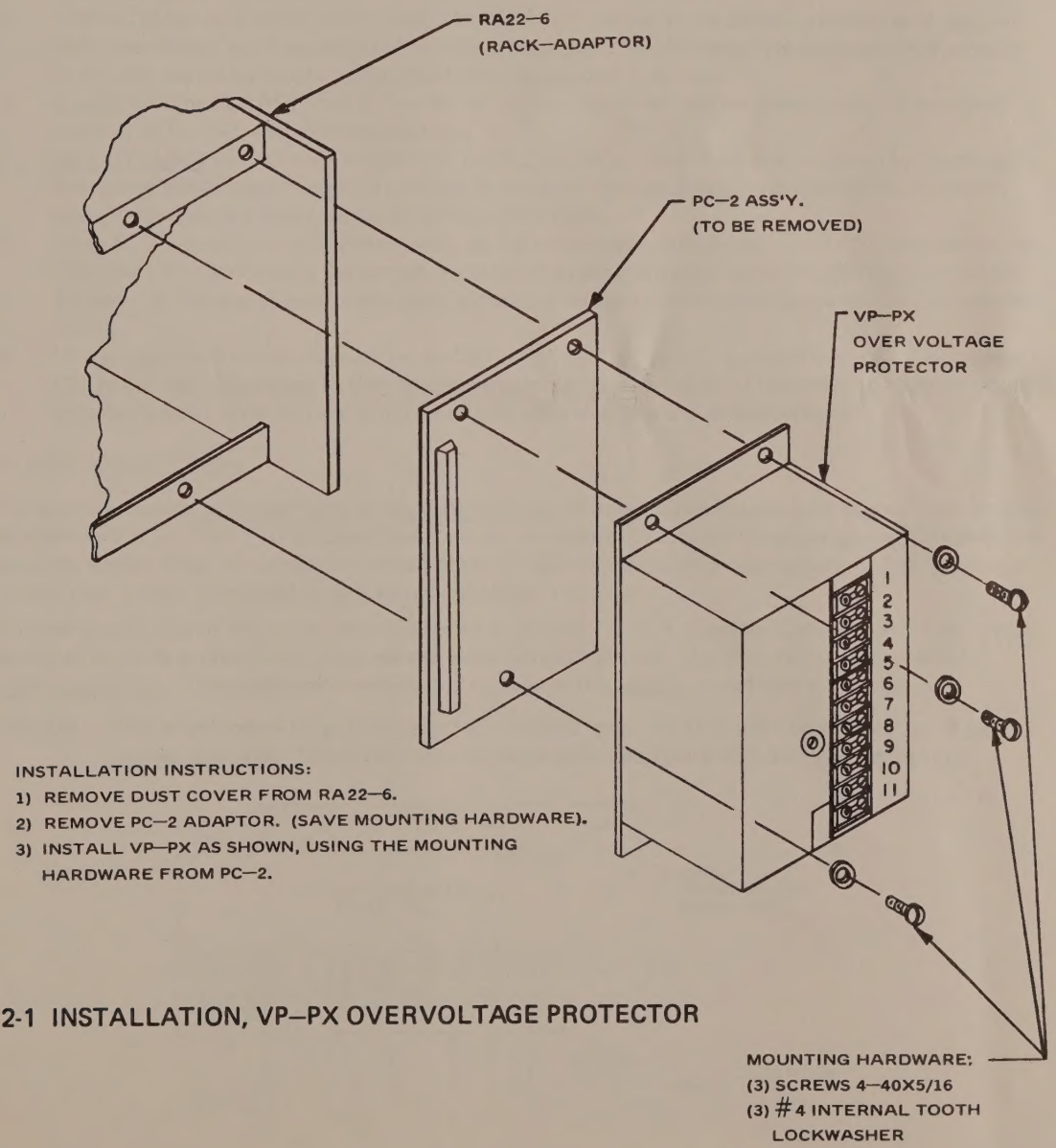


FIG. 2-1 INSTALLATION, VP–PX OVERVOLTAGE PROTECTOR

3-1 INITIAL ADJUSTMENTS AND TEST

3-2 The static trigger level of the VP device (COARSE and FINE adjustment) has been factory set to its maximum range and must be adjusted BEFORE LOAD CONNECTION to the desired cut-out point:

a) Refer to the applicable connection diagram below (FIG. 3–1 or 3–2)

b) Select a "Voltage Control" resistor according to the desired power supply output voltage. The control ratio for all Kepco modular power supplies is 1000 ohms per volt. For each volt of output, 1000 ohms control resistance is therefore required. (To cover the full output range a rheostat may be selected. For example the PAR–4 would require 4 K Ω, etc.) A high quality, wire wound or metal film resistor should be chosen. Refer to the power supply instruction manual for further details. (Section III)

c) A DC voltmeter (M1), and an AC power switch (S1) complete the test set-up. Connect components as shown in FIG. 3–1 or 3–2.

d) Turn the COARSE and FINE controls on the VP device fully clockwise. (The controls are clearly marked on the cover).

e) Turn AC power switch (S1) "on". Set POWER SUPPLY Voltage to the desired operating level, plus the static overvoltage, e.g. if an output of 40 volts is needed and the VP device is to short-circuit or crowbar at 42 volts, the power supply output should first be adjusted to 42 volts.

f) Slowly, turn the COARSE control * on the VP counter clockwise until the power supply output goes suddenly to 0.7 — 1 volt. (Crowbar point).

g) Back off slightly on the power supply VOLTAGE CONTROL. Re-activate the VP device by momentarily interupting the AC power (open S1). Note: If the output voltage does not reappear on the voltmeter, back off more on the power supply VOLTAGE CONTROL.

h) Close AC power switch again. Slowly bring up the power supply VOLTAGE CONTROL and observe the VOLTMETER connected to the output. Note the crow-bar point and readjust the FINE control on the VP device to the desired static overvoltage (difference voltage between power supply output and crowbar point).

i) "Triggering Time" may be adjusted on the DELAY control on the VP. A range of about 1:2 is provided (See par. 1–5d) The triggering time becomes shorter and the sensitivity of the circuit to spurious triggering becomes greater, as the DELAY is turned counter clockwise (as much as one turn).

3-3 LOAD CONNECTION

3-4 For applications with short load wires of adequate diameter the load may be connected in place of the voltmeter as shown in FIG. 3–1 and FIG. 3–2 and operation can commence. If the load is located remotely however, the load wire voltage drop may exceed the desired threshold voltage and impair proper operation. For this reason, remote error sensing is provided on all Kepco Overvoltage Protectors.

3-5 Remote jumper links on the barrier strip as directed in FIG. 3–3 or 3–4. Connect load as shown. Load wires should be as heavy as practicable. Error sensing leads should be at least AWG #20, twisted and shielded. Observe polarities: The positive error sensing lead must go to the positive output wire at the load.

*ATTENTION: With power supply output voltages of 20 volts and lower, the COARSE control must be set fully counter clockwise. Adjustment of the crowbar point takes place with the FINE control only.

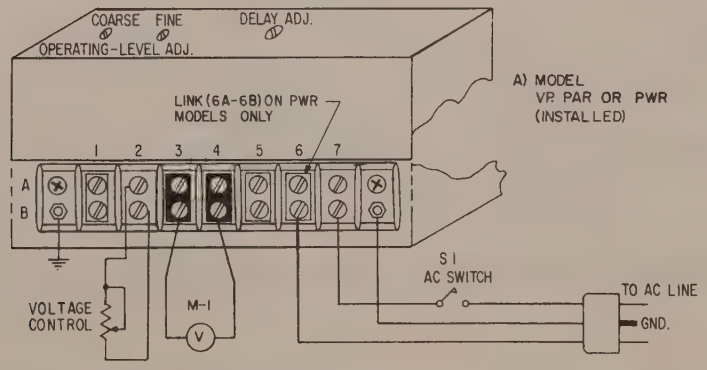


FIG. 3-1 CONNECTIONS FOR ADJUSTMENTS AND TEST, VP–PAR/PWR

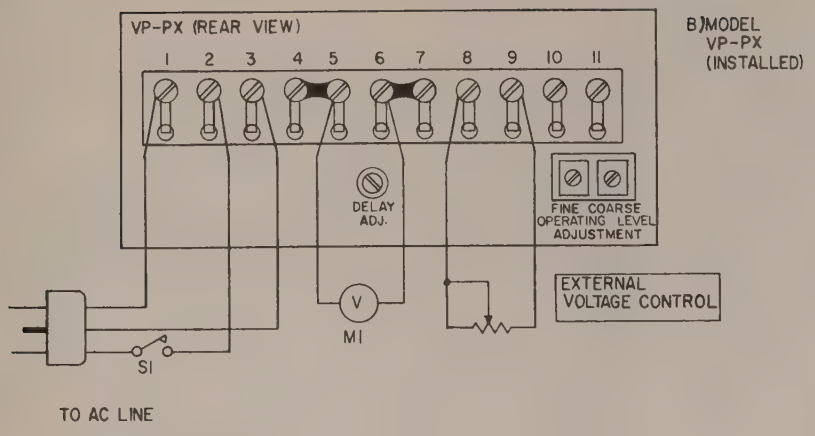


FIG. 3-2 CONNECTIONS FOR ADJUSTMENTS AND TEST, VP–PX

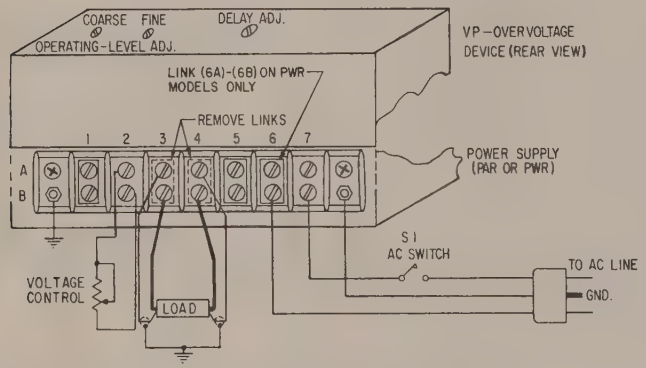


FIG. 3-3 LOAD CONNECTION WITH ERROR SENSING, VP–PAR/PWR

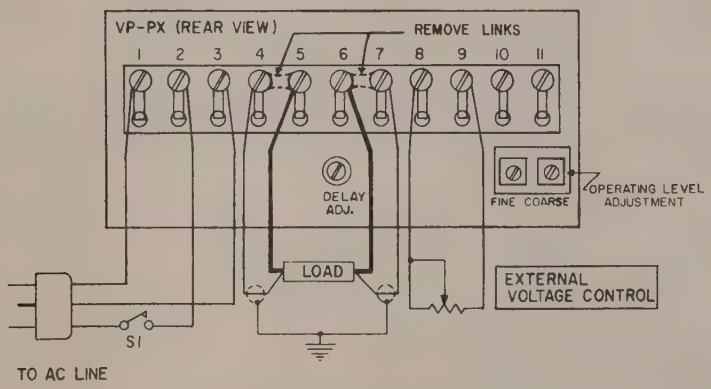


FIG. 3-4 LOAD CONNECTION WITH ERROR SENSING, VP–PX

SECTION IV – THEORY OF OPERATION

4-1 GENERAL

4-2 This section describes the major circuitry of the Kepco VP Overvoltage Protector. The purpose of the analysis is to provide the user with a functional understanding of the equipment, thus forming a basis for successful operation and maintenance.

4-3 BLOCK DIAGRAM

4-4 Circuit operation is best described by means of the block diagram. (FIG. 4–1)

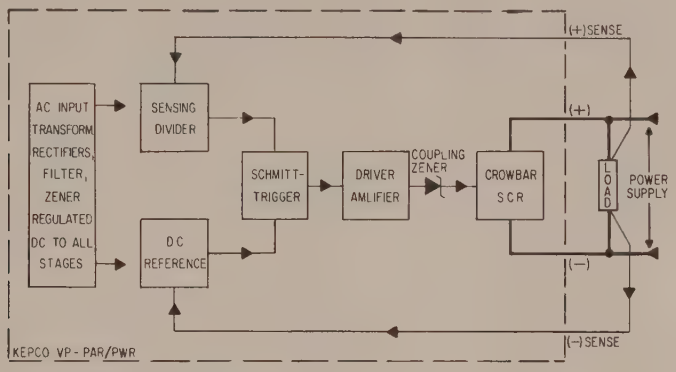


FIG. 4-1 BLOCK DIAGRAM

a) The power supply output voltage is sensed across the load and connected to a DC reference voltage and a resistor divider.

b) The DC reference is continuously compared to a portion of the sensing voltage. At balance, the sensing voltage is less than the reference voltage minus 0.1 volt, and the circuit is inactive.

c) Should an overvoltage occur, the divider voltage will exceed the DC reference level (minus 0.1 volt) and thereby activate the Schmitt Trigger circuit. This will turn-on the Transistor Driver/Amplifier. The amplified signal, transfered through the Coupling Zener will finally trigger the Crowbar S.C.R.

4-5 CIRCUIT DESCRIPTION (Refer to Schematic, FIG. 6–1)

a) AC INPUT CIRCUIT. AC power is introduced parallel to the power supply input terminals. The input power transformer is equipped with a dual winding, for 115 V AC or 230 V AC operation. A change of the VP transformer connections is required only on PWR models with 230 V AC input: Remove two jumpers between (1)–(2) and (3)–(4) on T1. Place one jumper between (3)–(4) on T1, (See FIG. 5–3).

b) DC POWER SUPPLY. The DC operating voltage is derived from a center-tapped winding on T1. A full wave rectifier circuit, consisting of CR1 and CR2, and a capacitor filter (C1) provide for the raw DC voltage. Zener regulator diode CR4 holds the operating voltage at a constant nominal 15 volts.

c) SCHMITT–TRIGGER/AMPLIFIER AND DRIVER STAGES
The Schmitt trigger stage (Q3, Q4) functions as a voltage comparator or sampling circuit by causing Q3 to change states as the base voltage of Q4 is altered. * The collector voltage of the stage is rigidly clamped to +6.5 volts reference voltage. If the base voltage is therefore increased by a voltage signal from the divider (due to overvoltage) turn-on in the driver-stage (Q1, Q2) results in a positive signal to the coupling zener diode (CR3) and the gate of crowbar S.C.R. (CR6).

d) CROWBAR CIRCUIT. The crowbar S.C.R. is connected directly across the output of the power supply, providing a short circuit once the device is turned on by the action described above. Change of state will only take place when the DC power is completely removed from the device.

*C_T is an adjustable trim capacitor determining the charging time constant at the output of the Schmitt-Trigger Stage which may be controlled over range of approximately 1:2.

5-1 GENERAL

5-2 Conservative component rating and uncongested layout in the Kepco Overvoltage protectors should keep maintenance problems to a minimum. If component failure should take place however, all parts are easily accessible and quickly identified by means of the component location drawing (FIG. 5–4) and the parts list (Section VI)

5-3 PRECAUTIONS

5-4 No parts in this device should be replaced with substitutes not specified in the parts list. No adjustments or circuit changes must be made other than those described in this manual. Substitution of parts not specified or unauthorized circuit changes made without understanding the effects, may cause serious damage to the VP device, the associated power supply or the connected load.

5-5 FUNCTIONAL TEST

5-6 Incomming inspection, or service personnel after repair, may have to test the VP before it is permanently installed and connected to the power supply. Since the VP has its own power transformer, this is readily accomplished by referring to FIG. 5–1 (or FIG. 5–2) and following the procedure given below.

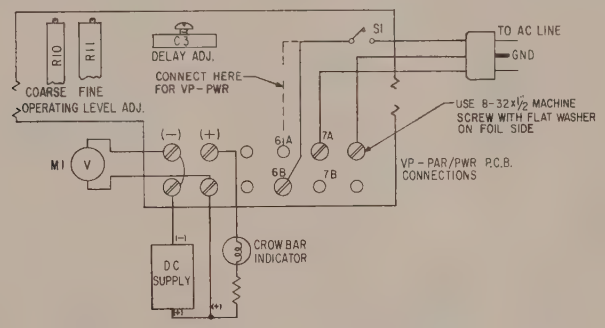


FIG. 5-1 TEST SET-UP FOR VP-PAR & VP-PWR OVERVOLTAGE PROTECTORS

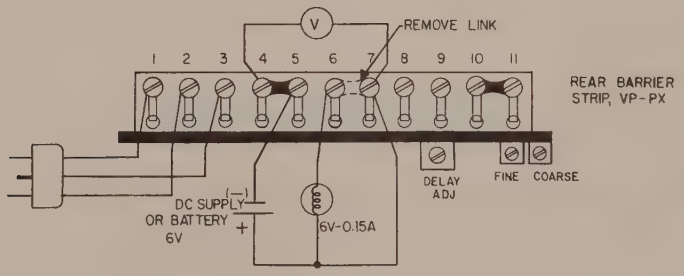


FIG. 5-2 TEST SET-UP FOR VP-PX OVERVOLTAGE PROTECTORS

5-7 PROCEDURE, VP CHECK-OUT

a) EQUIPMENT REQUIRED:

1) Variable (of fixed) DC supply, output within the range of the tested VP and able to drive the crowbar indicator. (A Battery and an incandescent bulb may be used).
2) Crowbar indicator, incandescent bulb with series resistor, values according to supply used.
3) Line cord with on-off switch (S1).
4) Meter for output voltage monitoring (M1).

b) Before turning AC power "on", turn "COARSE" operating level adjustment (R10) and DELAY control (C3) fully clockwise.

c) Turn test set-up "on". Turn COARSE control (R10) slowly counter clockwise until crowbar indicator lights up * Note crowbar voltage and correct if necessary with FINE control (R11). Re-activate test set-up by removing and then re-applying AC line power. Check crowbar voltage again. This concludes the functional test.

*NOTE: If a DC source of less than 20V is used, the COARSE control is turned to its maximum counter clockwise position. Adjustment of the crowbar or cut-out point takes place with the FINE control only.

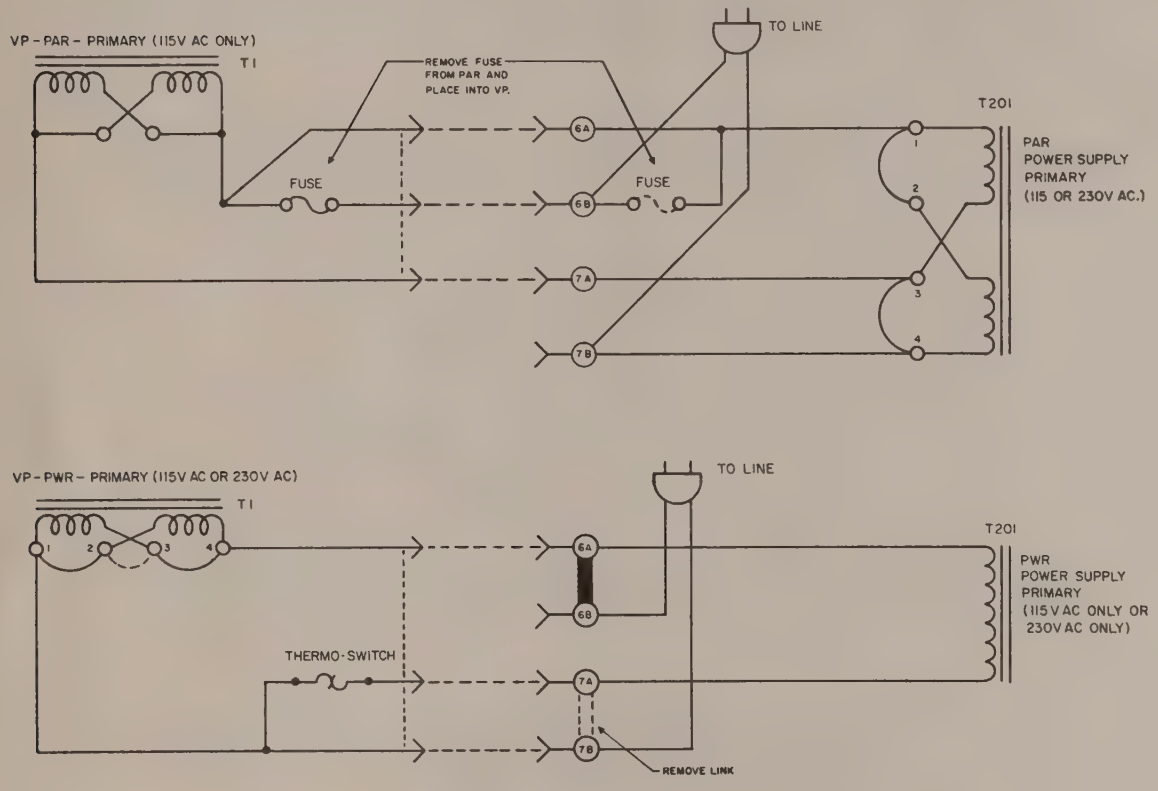


FIG. 5-3 AC INPUT CONNECTION DETAILS, VP–PAR AND VP–PWR

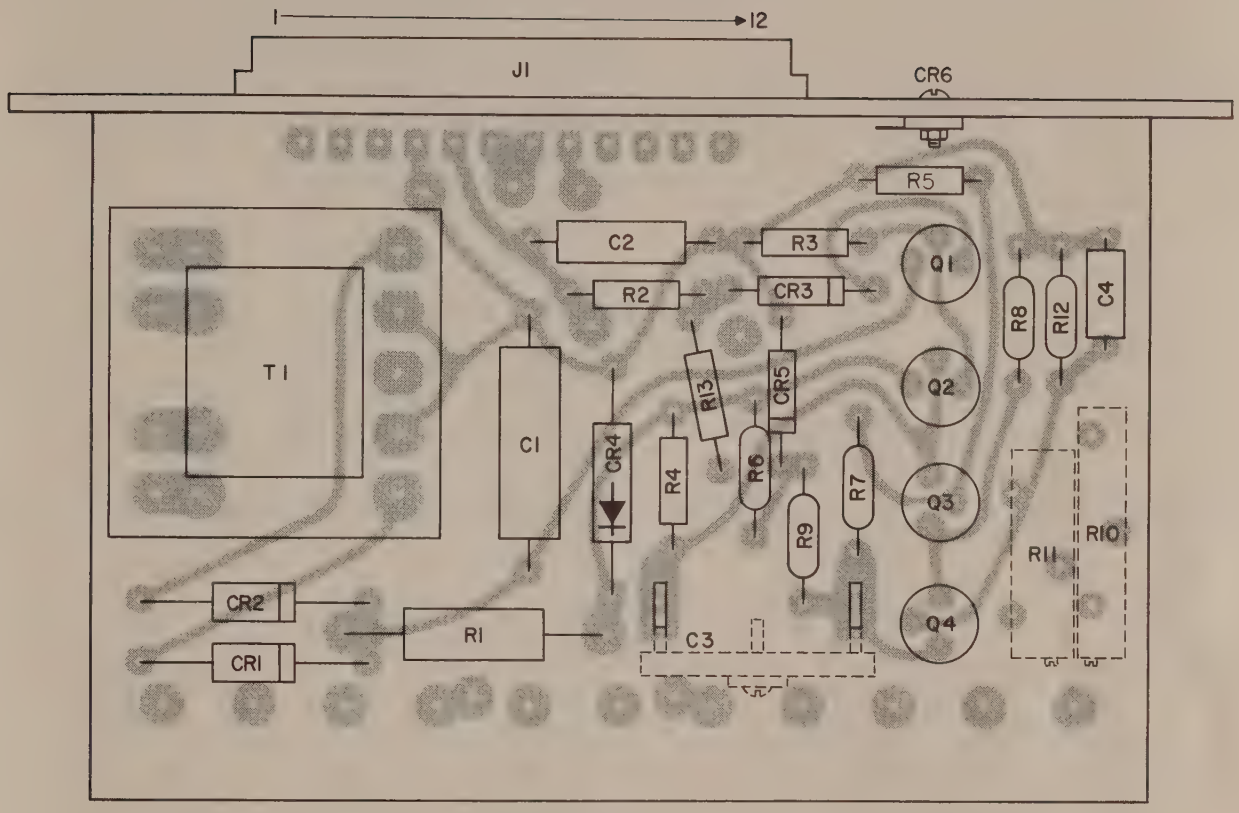


FIG. 5-4 COMPONENT LOCATION, PCB

SECTION VI – ELECTRICAL PARTS LIST AND DIAGRAMS

6-1 GENERAL

6-2 This section contains the main schematic, the parts location diagrams, and a list of all replaceable electrical parts. All components are listed in alpha-numerical order of their reference designations. Consult your Kepco Representative for replacement of parts not listed here.

6-3 ORDERING INFORMATION

6-4 To order a replacement part or to inquire about parts not listed in the parts list, address order or inquiry either to your authorized Kepco Sales Representative or to:

KEPCO, INC.
131–38 Sanford Avenue
Flushing, N.Y. 11352

6-5 Specify the following information for each part:

a) Model and complete serial number of instrument.

b) Kepco part number.

c) Circuit reference designator.

d) Decription.

6-6 To order a part not listed in the parts list, give a complete description and include its function and location.

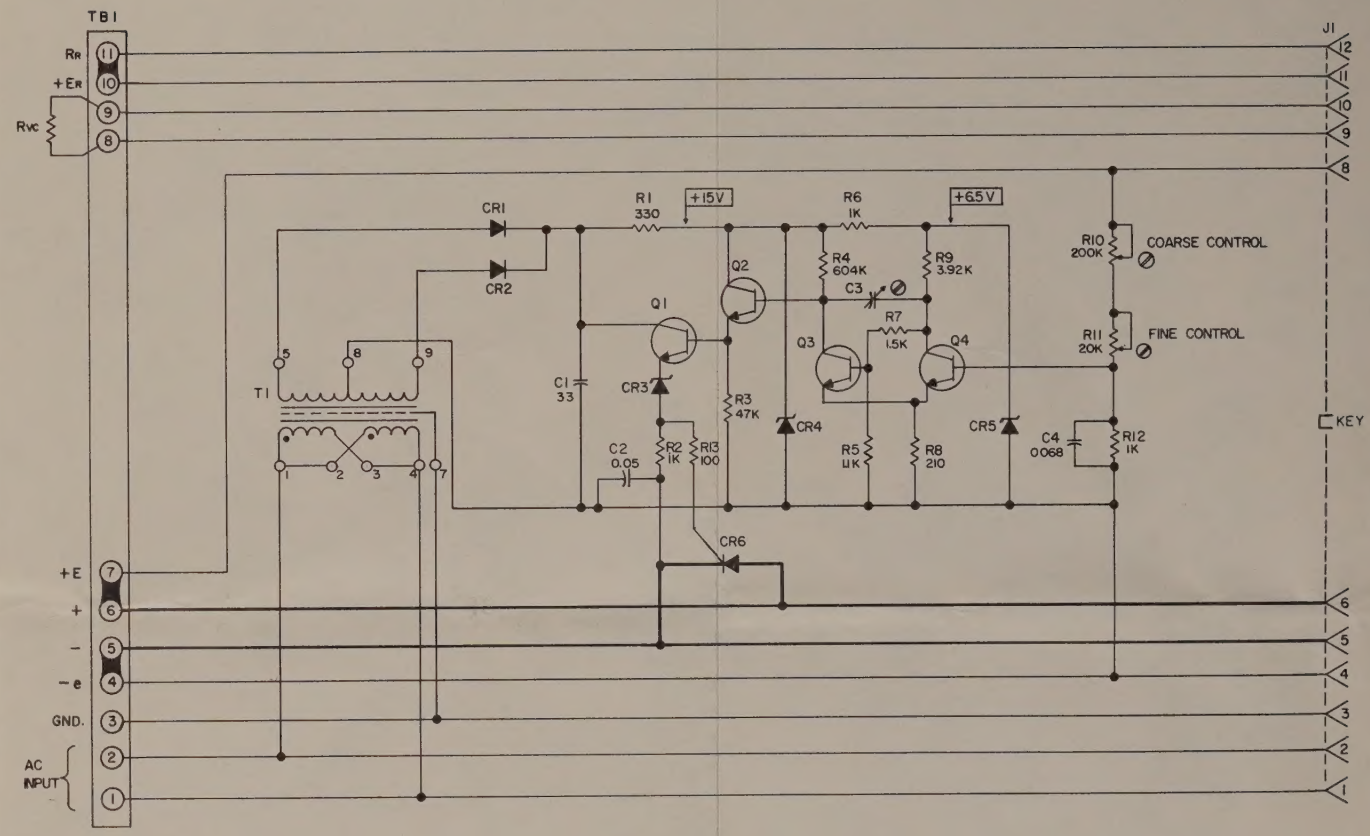
REPLACEMENT PARTS LIST

OVERVOLTAGE PROTECTOR, MODEL VP–PX Code 4-2468

SCHEMATIC NO.	QTY.	DESCRIPTION	MFRS. NAME & PART NO. (SEE NOTE)	KEPCO PART NO.
C1	1	Capacitor,Electrolytic,Pigtail 33 μF, 50 V, 20%	General Electric 76F02LL330	117-0581
C2	1	Capacitor,Mylar,Pigtail 0.05 μF, 200 V	Sprague 192P503025	117-0315
C3	1	Capacitor,Variable 80–480 pF, 175 V	Elmenco T52617-7	117-0637
C4	1	Capacitor,Mylar,Pigtail 6800 pF, 200 V	TRW 663-UW	117-0552
CR1,2	2	Rectifier,Silicon,Pigtail	Semicon SM110	124-0133
CR3,5	2	Zener Diode, Pigtail	Transitron SV125	121-0028
CR4	1	Zener Diode,	IRC 1N3024B	121-0057
CR6	1	Rectifier,Silicon,Controlled	Motorola 2N4442	124-0350
Q1	1	Transistor,Silicon,NPN	RCA 2N3053	119-0059
Q2,3,4	3	Transistor,Silicon,NPN	General Electric 2N336A	119-0056
R1	1	Resistor,Fixed,Molded 330 ohm, 2 W, 5%	Allen Bradley GB3315	115-0882
R2	1	Resistor,Fixed,Molded 1 K ohm, 1/4 W, 10%	IRC GBT Type	115-2238
R3	1	Resistor,Fixed,Molded 47 K ohm, 1/4 W, 10%	IRC GBT Type	115-2237
R4	1	Resistor,Fixed,Precision,M.F. 6.04 K ohm, 1/4 W, 1%	IRC CEA Type	115-2175
R5	1	Resistor,Fixed,Precision,M.F. 1.1 K ohm, 1/4 W, 1%	IRC CEA Type	115-2176
R6	1	Resistor,Fixed,M.G. 1 K ohm, 1/4 W, 5%	IRC RG 1/4	115-2188
R7	1	Resistor,Fixed,Precision,M.F. 1.5 K ohm, 1/4 W, 1%	IRC CEA Type	115-2178
R8	1	Resistor,Fixed,Precision,M.F. 210 ohm, 1/4 W, 1%	IRC CEA Type	115-2177
R9	1	Resistor,Fixed,Precision,M.F. 3.92 K ohm, 1/4 W, 1%	IRC CEA Type	115-2179
R10	1	Resistor.Variable,Cermet 200 K ohm, 3/4 W, 20%	Beckman 78PR200K	115-2045
R11	1	Resistor,Variable,WW 20 K ohm, 1/2 W	Bourns 3067P-1-203	115-1728
R12	1	Resistor,Fixed,Precision,M.F. 1 K ohm, 1/4 W, 1%	IRC CEA Type	115-2180
R13	1	Resistor,Fixed,Molded 100 ohm, 1/2 W, 5%	Allen Bradley EB1015	115-0341
T1	1	Transformer	Kepco Magnetics	100-1704

NOTE:
REPLACEMENT PARTS MAY BE ORDERED FROM KEPCO, INC. ORDERS SHOULD INCLUDE KEPCO PART NUMBER AND DESCRIPTION.

PLEASE NOTE: THE MANUFACTURER'S NAME AND PART NUMBER LISTED FOR EACH ITEM ON REPLACEMENT PARTS LISTS, REPRESENTS AT LEAST ONE SOURCE FOR THAT ITEM AND IS LISTED SOLELY FOR THE CONVENIENCE OF KEPCO EQUIPMENT OWNERS IN OBTAINING REPLACEMENT PARTS LOCALLY. WE RESERVE THE RIGHT TO USE EQUIVALENT ITEMS FROM ALTERNATE SOURCES. KEPCO, INC.



NOTES:
1. RESISTOR VALUES IN OHMS. K=1000.
2. CAPACITOR VALUES IN MICROFARADS, EXCEPT WHERE INDICATED OTHERWISE.
3. VOLTAGE READINGS IN RESPECT TO (–) ERROR SENSING TERMINAL UNDER THESE CONDITIONS:
   A) UNIT CONNECTED TO POWER SUPPLY AND AT BALANCE (SCR. NOT FIRED).
   B) INSTRUMENT 20K OHMS/V.
   C) MEASUREMENTS SUBJECT TO COMPONENT TOLERANCES.

Data subject to change without notice
PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

FIG. 6-1 MAIN SCHEMATIC, MODEL VP–PX

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352 • (212) 461-7000 • TWX #710-582-2631 • Cable: KEPCOPOWER NEWYORK

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